THE STATUS OF DEER

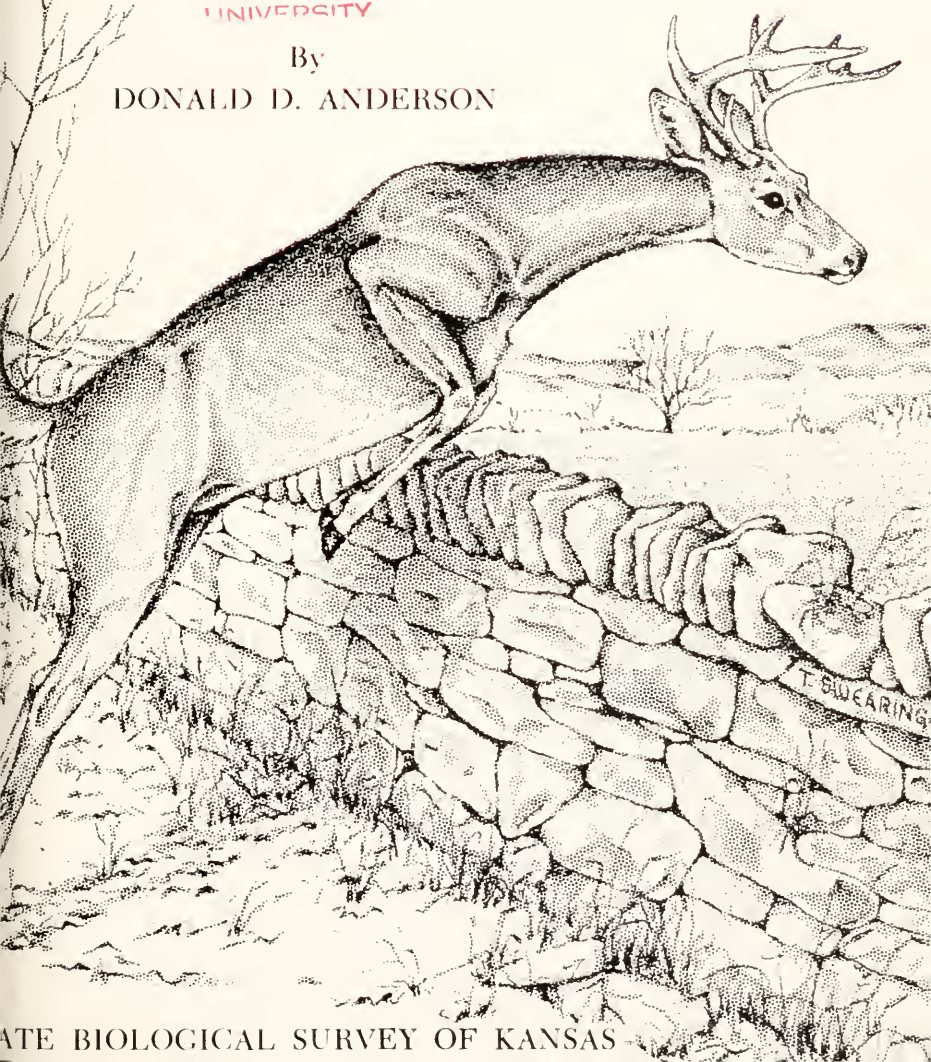
IN KANSAS

MUS. COMP. ZOOL.
LIBRARY

APR 14 1972

HARVARD
UNIVERSITY

By
DONALD D. ANDERSON



ATE BIOLOGICAL SURVEY OF KANSAS

The Status of Deer In Kansas

BY

Donald D. Anderson

State Biological Survey of Kansas

University of Kansas
Museum of Natural History

EDITOR: E. RAYMOND HALL

Miscellaneous Publication No. 39, pp. 1-36, 8 maps
Published September 28, 1964

Lawrence • Kansas

PRINTED BY
HARRY (BUD) TIMBERLAKE, STATE PRINTER
TOPEKA, KANSAS
1964

30-3969

The Status of Deer in Kansas

BY

DONALD D. ANDERSON

CONTENTS

	PAGE
Introduction	4
History	5
Mule Deer	5
White-tailed Deer	6
Present Status of Deer in Kansas	8
Mortality	17
White-tailed Deer in Northeastern Kansas	21
Description	21
Status in Douglas County	25
Food Habits	27
Reproduction	30
Parasites	32
Conclusions and Recommendations	33
Acknowledgments	34
Literature Cited	35

INTRODUCTION

Deer are without doubt the most popular big game animals in North America. They are widely distributed, are more numerous than other big game species, and are able to maintain themselves and even increase in areas heavily populated by man. Economically, deer are an important source of revenue for state game departments as well as sporting goods stores and other businesses that serve the hunter. For the sportsman, deer not only provide meat for the table, but give him a chance to test his skill as a hunter and a marksman. The aesthetic value found by the public in deer is based on their beauty and gracefulness as well as their fascinating habits.

Although both mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) occur in Kansas, it is the only state that has not had an open season within the past several years. As the white man advanced westward many animals including deer were extirpated, or nearly so. In the Great Plains region, deer were killed off during the late 1800's. Lack of interest in conservation of natural resources along with inadequate protection and law enforcement were responsible for slowing the recovery of deer during the early 1900's. Nebraska, Iowa, Illinois, Oklahoma, Missouri, and Arkansas all experienced a decline in deer herds, which were smallest around the turn of the century. All of these states succeeded in restoring herds through management, protection, and natural dispersal, and now have open seasons. Kansas is the last of the Plains states to benefit from natural dispersal of deer from surrounding areas, and only recently have deer become re-established in the state. Adequate law enforcement by discouraging poaching has been an important factor enabling deer to increase. As a result of increasing numbers of deer in Kansas, the state legislature in 1963 authorized the Kansas Forestry, Fish, and Game Commission to declare an open season on deer when feasible or necessary.

Kansas needs a research program for deer to insure proper management. It was with this thought in mind that my study was undertaken. It had four principal objectives as follows:

(1) To record the history of deer in Kansas.

(2) To determine the overall status of deer in Kansas as to present numbers, distribution, and population trends.

(3) To determine some procedures and methods best applicable to management of Kansas deer.

(4) To learn as much as possible, incidental to objectives 1-3, about the natural history of deer in Kansas.

Information was obtained in the following ways:

(1) Examination of preserved specimens.
(2) Cooperation with local Game Protectors.
(3) Observation of deer and their sign.
(4) Review of pertinent literature on deer.
(5) Interview of local residents.
(6) Examination of mortality reports filed by Game Protectors.
(7) Circulation of a questionnaire concerning the present status of deer in Kansas.

Only one other study (see Taylor and Elder, 1959) dealing exclusively with the deer of Kansas has been made.

Although my work was concerned primarily with the white-tailed deer, considerable information was obtained about mule deer from mortality reports and the questionnaire. Some of the statements beyond are based on conclusions reached by workers who studied deer in other states.

HISTORY

The history of deer in Kansas has not been documented well and the available information deals primarily with the presence or absence of deer in particular areas as reported by various persons. Apparently both the mule deer (black-tailed deer) and the white-tailed deer occurred in Kansas at the time of its settlement by the white man. The terms "mule" and "black-tailed" deer were used interchangeably in early reports as they are today, and the white-tailed deer often was called the "Virginia deer."

Mule Deer

According to Lantz (1905A:342) the mule deer (*Odocoileus hemionus* Rafinesque) was rather common over the greater part of Kansas, but was not mentioned as occurring there by explorers earlier than Thomas Say in 1823. Previous explorers mentioned deer as occurring in the state, but did not distinguish the species.

Mead (1899:281) observed that mule deer were numerous during the winter of 1859 in the hills between the Saline and Solomon rivers, occurring in groups of from three or four to as many as twenty or thirty. He thought they came down from the Colorado foothills to winter, as he did not see them in summer. Migrations

of mule deer of from 50 to 100 miles to winter ranges were reported by Einarsen (*in* Taylor, 1956:461); consequently, Mead may have been correct in assuming that the deer migrated.

Phillips (1890:351) reported that small bands of mule deer were present among the bluffs and cedars of the upper reaches of the "Smoky," Saline, and Solomon rivers as late as 1866. J. A. Allen (1874:48) noted that the species was more or less common along the wooded parts of streams in central and western Kansas, especially on the Smoky and Paradise rivers in 1871. Kellogg (1915, manuscript) reported that what was probably the last mule deer in Logan County was killed in 1885 by Jay Swink and Jink Davis. Baker (1889:57) observed that near Wakeeney in Trego County the mule deer was common until the late 1880's. After that individuals were found only occasionally, and in the roughest country. Early settlers of Wallace County told Lantz (1905A:342) that the mule deer occurred in considerable herds in the hills south of Fort Wallace during the seventies and early eighties. Lantz (1905B: 172) reported that the species was still found in western Kansas in 1884, but had probably disappeared by 1905.

Hibbard (1933:247 and 1944:86) and P. B. Allen (1940) believed that the mule deer was extinct in Kansas. However, Tihen and Sprague (1939:509) noted that a number of these deer were introduced into the Meade County State Park area, and that they were increasing each year. Also, they reported that a few wild deer still were present along the Cimarron Breaks in the southwestern part of the state. Cockrum (1952:272) noted that twenty mule deer had been moved from the state park in Meade County and released in Morton County in 1950.

White-tailed Deer

According to Kellogg (1915, manuscript), the Lewis and Clark Expedition reported an immense number of deer on the banks of the Missouri River near the present site of Kansas City, Kansas, in 1804. Kellogg also reported that Zebulon Pike found deer in 1806 in what are now Woodson, Coffey, Lyon, Chase, and Morris counties. Edwin James (see Thwaites 1905, 14:175) reported that between two and three thousand deer were killed by the detachment under Captain Martin in the vicinity of Cow Island on the Missouri River during the winter of 1818-19. This island was about even with the boundary separating Atchison and Leavenworth counties. Large numbers of deer must have been present in eastern Kansas at that time if the above accounts are correct.

The kind of deer present was not mentioned in any of the accounts cited, but probably was the white-tailed deer because the habitat in the area is primarily the oak-hickory association in which the mule deer does not occur.

Mead (1899:281) wrote that white-tailed deer were numerous in the hills about the forks of the Solomon River and in the hilly country of Barber and Comanche counties in 1859, and were occasionally found elsewhere. Kellogg (1915, manuscript) reported that in 1867 two men by the names of Livsa and Wilcox killed more than one hundred whitetails near the mouth of Lightning Creek on the Neosho River. Ross MacDonald killed a doe at Chetopa, Labette County, in 1861, and Dave Dunham killed a buck on Lightning Creek near Columbus, Cherokee County, in 1896. The latter was the last deer reported in that part of Kansas according to Kellogg. Knox (1875) noted that the "Virginia deer" was common in large bodies of timber in different parts of the state.

Lantz (1905B), Kellogg (1915, manuscript), Hibbard (1933 and 1944), Black (1937), and P. B. Allen (1940) all considered the white-tailed deer to be extinct in the state. Tihen and Sprague (1939:509) reported that the species was introduced into the Meade County State Park where it became well adapted and increased as long as the herd remained in the protected area. Cockrum (1952: 273) reported that three whitetails, two bucks and one doe, were introduced from Texas into Cowley County; according to him these deer were plentiful, at least locally, within a radius of 50 miles of Arkansas City by 1948. Cockrum further wrote of the species as follows: "In eastern Kansas, since 1945, several white-tailed deer have been observed. Every year a number of newspaper accounts concerning such observations are published. Apparently the white-tailed deer is again becoming established in the eastern part of the state."

Cockrum recognized only one subspecies, *Odocoileus virginianus macrourus* (Rafinesque), as being native to Kansas, but mentioned that the deer present in the state at that time might be a mixture of two or more subspecies. Kellogg (*in* Taylor, 1956:42-44), in delimiting the geographical distribution of the subspecies of *O. virginianus*, indicated that two, *texanus* and *macrourus*, originally occurred in western and eastern Kansas respectively. No specimens of white-tailed deer from western Kansas were available to me for study in order to ascertain whether or not the subspecies *texanus* occurs there.

In the early 1930's several deer were held captive in Leavenworth County State Park near Tonganoxie, Kansas. Remains of two of these deer (skulls alone) are in the Museum of Natural History, The University of Kansas, and seem to be of the subspecies *Odocoileus virginianus virginianus*. Mr. D. R. Brune informed me that some deer were believed to have escaped from the park in the 1940's. I was unable to determine if any of these deer survived and reproduced.

F. R. Henderson (*in litt.*) related that he released one buck and three does near Eureka, Kansas, in the spring of 1958; wild deer occurred in the area at that time. Henderson believed these deer, which he purchased in Missouri, were the same subspecies that occurs in western Missouri, namely, *Odocoileus virginianus macrourus*.

Many other introductions of deer, of which we have no record, probably have occurred in Kansas. Introduction may have played an important part in the re-establishment of deer in the state.

PRESENT STATUS OF DEER IN KANSAS

In the spring of 1958, a questionnaire concerning the status of deer in Kansas was sent to all State Game Protectors, Work Unit Conservationists, and County Agricultural Agents by Dale L. Taylor and James B. Elder of Kansas State University. The results of their survey were printed in 1959 in the "Transactions of the Kansas Academy of Science" (62:67-79) and indicated that deer were increasing in number in Kansas. According to them, their study aimed "to determine the extent of this increase in terms of time, space, and relative numbers."

In the spring of 1962, I sent a similar questionnaire to the same three groups as did Taylor and Elder. The purposes of my survey were to determine population trends, distribution, present numbers, and attitudes of residents toward deer at the present time so that results could be compared with those obtained in 1958.

Of the 246 questionnaires distributed by me, 105 went to County Agricultural Agents, 105 to Work Unit Conservationists, and 36 to State Game Protectors. The questionnaire consisted of nine items, each of which required only a check mark or a few words from the respondent, excepting the last item which was reserved for his comments.

Item No. 1 called for the name and position of the person filling out the questionnaire. The resulting data are shown in Table 1. Sixty-seven counties were represented by three returns, 36 counties

by two returns, and two counties by one return. All counties were represented by at least one return. Not all questions were answered on some questionnaires.

Item No. 2 requested the respondent to state the boundaries of the area in which he regularly worked (and to which his remarks

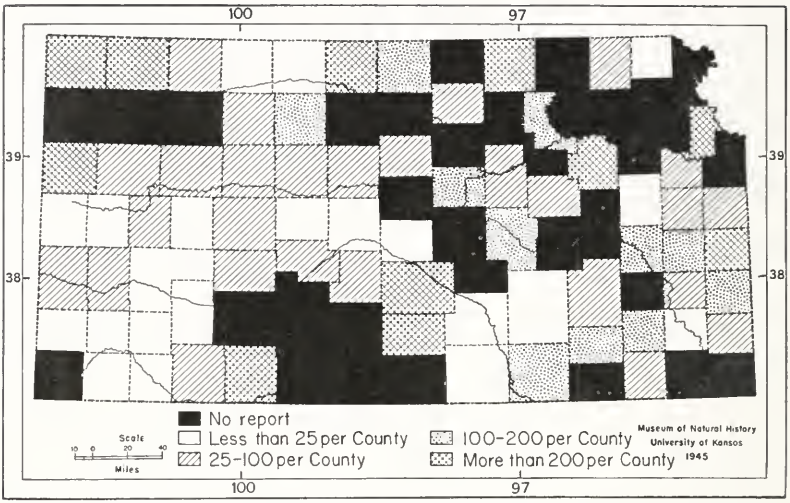
TABLE 1. RESPONSE TO QUESTIONNAIRE ON DEER IN KANSAS.

Respondents	Number sent out	Number returned	Per cent return	Number of counties	Per cent of 105 counties
County Agricultural Agents	105	93	88.5	93 of 105	88.5
Work Unit Conservationists	105	95	90.4	98 of 105	93.3
State Game Protectors	36	32	88.9	84 of 105	80.0
Totals	246	220	89.4		

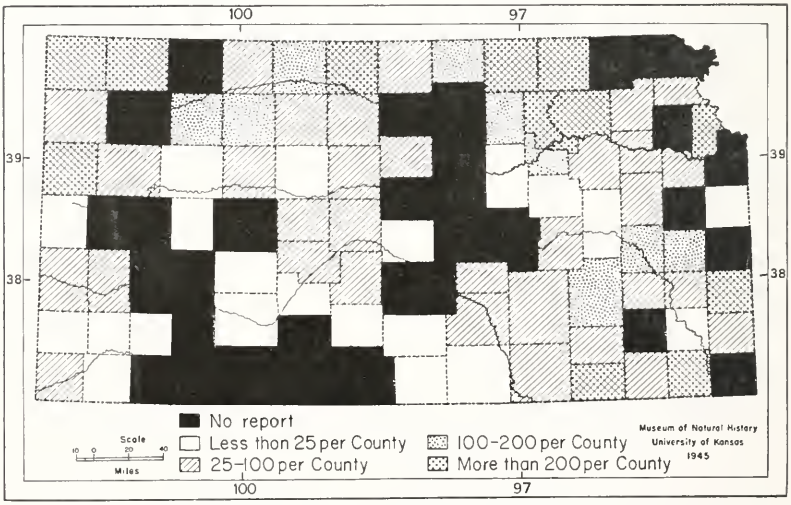
applied unless otherwise noted). The answers to this question were used in connection with items 3 and 8 to plot numbers and distribution of deer on maps of Kansas (see discussions under 3 and 8 below).

Item No. 3 called for an estimate of the total number of deer in the area reported on. The results are given in Tables 2 and 3, and Maps 1, 2, and 3. The numbers of deer estimated by each of the three groups of respondents were plotted by me, by county (by district for Game Protectors) on a map of Kansas in order to show the distribution and to compare it with the distribution shown by Taylor and Elder. Deer were reported as absent from only three counties. County Agents reported deer as absent from Lane, Stanton, and Seward counties. Conservationists reported no deer in Stanton County, whereas each Game Protector reported deer present in his district that included Stanton County. With regard to distribution, Taylor and Elder reported the results of their questionnaire as indicating that no deer were present in Pratt, Sumner, Allen, and Neosho counties. They reported also that the respondents did not agree as to the presence or absence of deer in some other counties. Apparently deer now occur in all counties of Kansas with the possible exception of Stanton County.

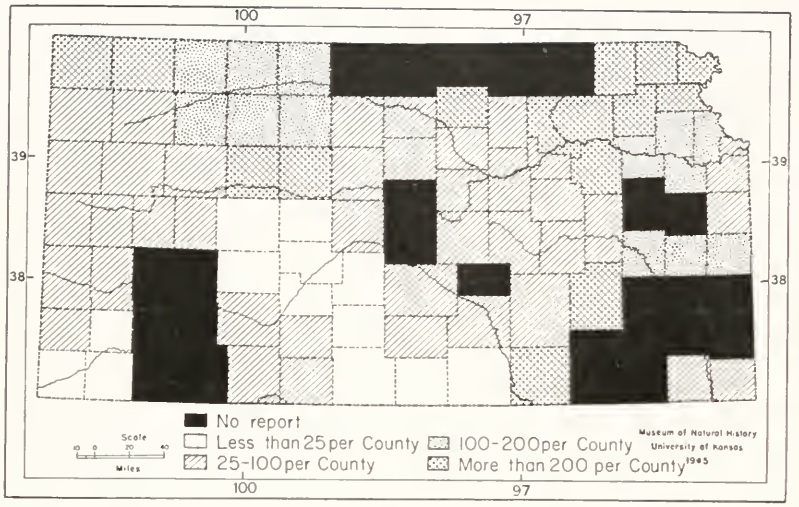
The estimates made by each group of respondents, when averaged together for each county, show the distribution and relative num-



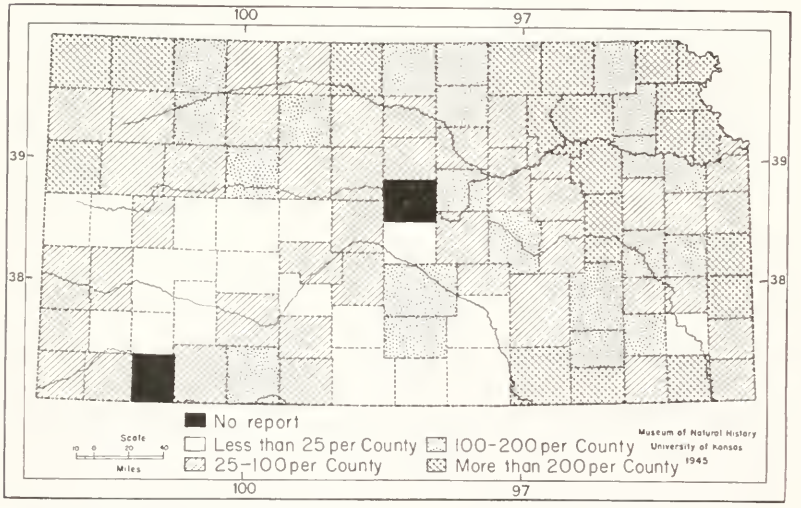
MAP 1. Distribution and number of deer in Kansas as estimated by County Agricultural Agents.



MAP 2. Distribution and number of deer in Kansas as estimated by Work Unit Conservationists.



MAP 3. Distribution and number of deer in Kansas as estimated by State Game Protectors.



MAP 4. Combined average estimates of deer in Kansas by County Agricultural Agents, Work Unit Conservationists, and State Game Protectors.

Table 2. Response to Question Three on the Questionnaire Relating to Deer Estimates by County.

Respondents	Number of counties for which estimates were received	Per cent of counties for which estimates were received
County Agricultural Agents.....	69	65.7
Work Unit Conservationists.....	75	71.4
State Game Protectors.....	81	77.1

bers of deer in Kansas as presented on Map 4. The estimates made by the three groups of respondents act as a check on one another. For some counties there was only one estimate, and from some others there were only two from which to obtain an average figure. Map 4 indicates that deer are most numerous in the northwestern, northeastern, and southeastern areas of the state, whereas fewer deer occur in the southwestern and south-central parts of the state. The distribution of relative numbers of deer as shown in Map 4 agrees with the distribution presented by Taylor and Elder, but many respondents reported more deer in 1962 than they did in 1958. For example, Taylor and Elder reported the heaviest concentrations of deer in northeastern Kansas to be in Nemaha, Brown, Doniphan, and Atchison counties; each were recorded as having more than 100 deer. Now Jefferson, Leavenworth, Riley, Pottawatomie, Washington, Marshall, Wabaunsee, Douglas, Jackson, and Shawnee counties could be included as well. Each of these counties is reported to have more than 100 deer and 10 of them have more than 200 deer, according to the estimates made by the three groups of respondents. Taylor and Elder reported Cheyenne, Rawlins, Wallace, and Thomas counties as having the most deer in the northwest, but now Decatur and Sheridan counties are reported to have more than 100 deer. Now more than 25 deer are estimated to be in each of many southwestern and south-central counties.

Taylor and Elder did not attempt to estimate the total population of deer in the state, realizing the potential error involved. In this questionnaire, estimates from the three groups were totaled separately in order to determine how much the estimates varied from one another (see Table 3). In many returns, estimates were given as being somewhere between two numbers such as 50-100, so that a minimum estimate was derived from the smaller number and the

TABLE 3. TOTAL ESTIMATES OF THE NUMBER OF DEER PRESENT IN KANSAS.

Respondents	Minimum estimate	Maximum estimate	Average estimate	Number of counties included in estimates
County Agricultural Agents	9,511	10,049	9,880	69
Work Unit Conservationists	8,210	9,940	9,075	75
State Game Protectors	10,252	10,909	10,580	81
Average	9,324	10,300	9,845	75

maximum from the larger number. The average estimate was determined by averaging the minimum and maximum numbers together. The estimates are in close agreement; the greatest margin of difference in the average estimates was approximately 1500. Total number for the state, as derived from the reports of any one group of respondents, was based only on counties for which there were estimates. Counties included or omitted are not the same for the 3 groups. The deer population in Kansas in 1961 was estimated by the Kansas Forestry, Fish, and Game Department at 10,686, but this figure was based on all counties, whereas the figures in Table 3 were derived from only about 60 to 80 percent of the counties. The total estimated population of deer would probably have been 20 to 40 per cent higher if all respondents had answered item No. 3 on the questionnaire.

In item No. 4 it was asked if the number of deer had increased, decreased, or remained stable in the period 1957-62. The results obtained from this question are presented in Table 4. In the southwestern part of the state, 28 replies estimated decreases or no change for 24 counties as compared to 30 reports of decreases or no change for the other 81 counties. The apparent slower increase of the deer population in the southwest probably is due to the smaller number of deer present in that area of the state. The three groups of respondents did not always agree on the population trend for a particular county; two might state, for example, that there had been no change, whereas the third respondent might state that deer were increasing in numbers. Taylor and Elder stated the question in this way: "If there has been a population increase (or decrease), for how long has it been apparent?" According to them, about 95 per cent of the 118 replies received reported that increases had been apparent only within the last ten

Table 4. Summary of Answers to Question Four on the Questionnaire Relating to Population Trends of Deer in the Period 1957-1962.

Respondents	Number of counties	Deer increasing	Deer decreasing	Deer unchanged	No information
County Agricultural Agents	91	59 (56.2%)	14 (13.3%)	18 (17.1%)	14 (13.3%)
Work Unit Conservationists	91	73 (69.5%)	5 (4.8%)	13 (12.6%)	14 (13.3%)
State Game Protectors	84	71 (67.6%)	5 (4.8%)	8 (7.6%)	21 (20.0%)
Totals	266	203	24	39	49

years, and 73 per cent reported increases had occurred only in the last five years. Four per cent stated that increases had been apparent for more than ten years. In my questionnaire 203 replies were received reporting increases compared to 118 in the study of Taylor and Elder. Nothing was mentioned in their report concerning decreases or no change in population.

In item No. 5 it was asked if a change in the deer population occurred in the period 1957-1962 and, if so, was the change abrupt or gradual. For the results from this question see Table 5. Taylor and Elder asked a similar question. Of 112 replies received by them, 92 per cent or 103 reported a gradual increase and nine considered the increase abrupt. I received 196 reports of a gradual increase and seven reports of an abrupt increase. Each of the seven respondents reporting abrupt increases were from different counties; 12 returns from these same seven counties reported a gradual increase.

In item No. 6 it was asked whether or not deer were evenly distributed throughout the area reported on, and, if not, whether they were concentrated in grassland, brushland, upland timber, or bottomland timber. See Table 6 for the replies to this question. As was expected, many respondents reported deer occurring in more than one type of habitat. Only six reported deer in all four types of habitat. If this question was unanswered it was assumed the respondent meant that deer were evenly distributed in his area. In general, bottomland areas occur in all parts of the state and it would seem only natural to have more reports of deer occurring in

TABLE 5. SUMMARY OF ANSWERS TO QUESTION FIVE ON THE QUESTIONNAIRE CONCERNING SUDDEN OR GRADUAL CHANGES IN THE DEER POPULATION FOR THE PERIOD 1957-1962.

Respondents	Number of counties	Increase gradual	Increase abrupt	Decrease gradual	Decrease abrupt
County Agricultural Agents	73	55	4	14	0
Work Unit Conservationists	78	70	3	5	0
State Game Protectors	76	71	0	5	0
Totals	227	196	7	24	0

this type of habitat. Upland timber is absent in many counties, especially in the western half of the state, resulting in fewer reports for this type of range. Taylor and Elder stated that deer were concentrated in river- and creek-bottoms, with some dispersion into upland timber in some eastern counties. They also reported that of 197 replies only 6.5 per cent credited deer with being uniformly distributed, whereas 7 per cent of 220 replies to my survey indicated that the distribution was uniform.

In item No. 7 it was asked what the general attitude at present of farmers and other residents was regarding deer and a deer

TABLE 6. NUMBERS OF RESPONDENTS REPORTING CONCENTRATION OF DEER IN BOTTOMLAND TIMBER, UPLAND TIMBER, GRASSLAND, AND BRUSHLAND.

Respondents	Bottomland timber	Upland timber	Brushland	Grassland
County Agricultural Agents	69	22	18	11
Work Unit Conservationists	89	23	16	16
State Game Protectors	32	12	13	4
Totals	190	57	47	31

season. A total of 207 replies was received for this question (see Table 7). A favorable attitude toward deer was reported by 202 respondents; only 5 reported an unfavorable attitude by residents. Of 197 replies, Taylor and Elder, in their report, stated that 132 indicated a favorable attitude toward deer; 40 were neutral; only

three reported an unfavorable attitude. With regard to a deer season, 22 respondents to my questionnaire reported residents generally in favor of a season, 126 against, and 59 expressed no opinion. Taylor and Elder reported that of 194 replies, 57 were favorable, 77 unfavorable, and 60 expressed no opinion regarding a future deer season in Kansas. A comparison of these results cannot be made as my question concerned a season at the present time, whereas Taylor and Elder were concerned with a season sometime in the future if deer continued to increase. Probably this question

Table 7. Summary of Answers to Question Seven of the Questionnaire Concerning the General Attitude of People at the Present Time Toward Deer in Kansas.

Respondents	Favorable	Unfavorable	Want deer protected	Want deer hunted
County Agricultural Agents	83	1	44	8
Work Unit Conservationists	89	3	64	8
State Game Protectors	30	1	18	6
Totals	202	5	126	22

was difficult for respondents to answer because the farmer and the sportsman often have differing views with regard to wildlife management policies. Even so, a majority of each group of respondents felt that public sentiment was against a deer season at the present time. Taylor and Elder reported that a majority of the Game Protectors expressed an opinion that the public was generally in favor of a season in the future if it was feasible or necessary.

In item No. 8 the respondents were requested to indicate what kind of deer were present in their areas and, if possible, to estimate the ratio of mule deer to white-tailed deer if both were present. Maps 5, 6, and 7 show the distribution of mule deer and white-tailed deer as reported by each group of respondents. Mule deer were reported from 38 counties and white-tailed deer from 101 counties. Most mule deer apparently occur in the northwestern part of the state and east as far as Republic and Cloud counties. Reports of mule deer in Linn, Elk, and Wilson counties in southeastern Kansas are viewed with suspicion because the probability of the species occurring there is slight (but not impossible). Probably the distribution of mule deer as given by the Game Protectors is the most

nearly accurate as they should be more familiar with the kind of deer present than the other respondents. The three groups of respondents were in agreement that the mule deer outnumber the white-tailed deer in Cheyenne, Rawlins, and Sherman counties.

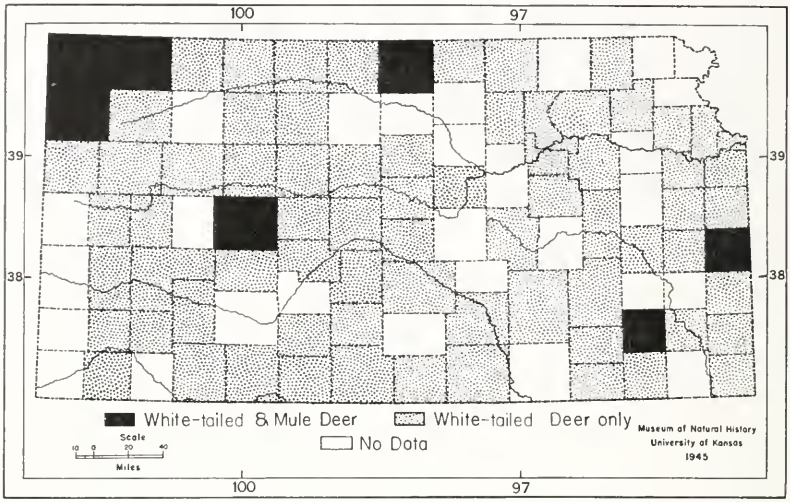
Item No. 9 stated that the reverse side of the questionnaire could be used for additional comments. Most comments were about deer sightings, road-kills, where most deer occurred in a county, opinions concerning a deer season, and crop damage. Some respondents thought that poaching was being done in their areas. Only nine comments were received about crop damage, indicating that little noticeable damage has been done by deer up to now. Many respondents indicated that as deer increase and crop damage thus becomes more evident, the attitude of farmers toward deer may become less favorable. Many farmers were not in favor of a season because they feared for their livestock and themselves if high-powered rifles were used.

A great difference of opinion was evident among individuals answering my questionnaire. Nevertheless, the large number of respondents helped to determine general trends and status of deer populations in Kansas.

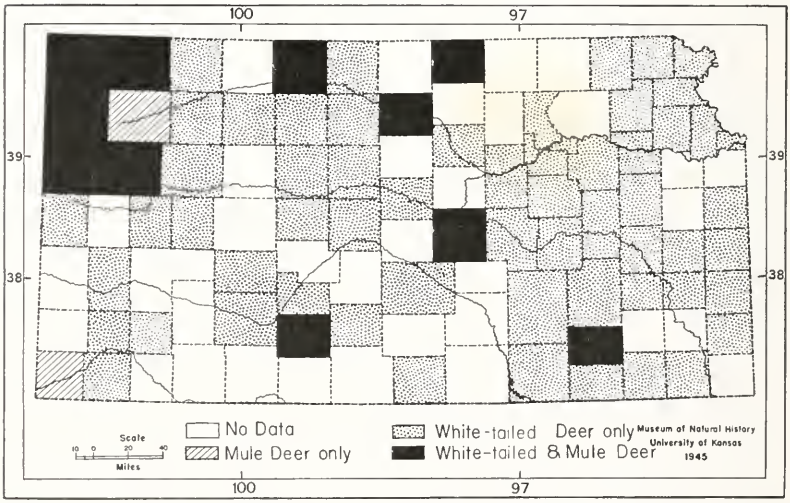
MORTALITY

Information on deer mortalities was obtained from the reports filed with the Kansas Forestry, Fish, and Game Department by the State Game Protectors. Of 283 deer deaths investigated by Game Protectors from April 8, 1962, to February 25, 1963, 231 or 82 per cent were involved in traffic accidents, 21 or 7 per cent were shot illegally, 14 or 5 per cent were killed in miscellaneous accidents, and 17 or 6 per cent died from causes unknown.

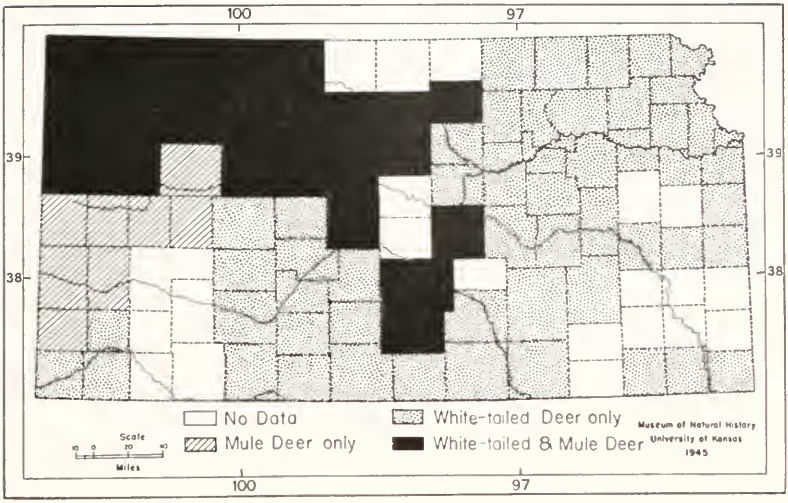
Probably none of the deer starved to death. Starvation occurs primarily in the more northern states where deer herd together in deer yards for protection and warmth during the winter. The deep snow prevents them from moving about and the edible vegetation in the area is often consumed before winter is over. Deer in Kansas also tend to herd together; herds of up to 30 or 40 have been observed by residents. The winters are less rigorous in Kansas than in more northern states and snow rarely accumulates to more than a foot in depth. Deer thus are able to move about in winter in order to obtain food. I have seen no indication of over-browsing; nevertheless, a close check should be kept on browse species if deer continue to increase.



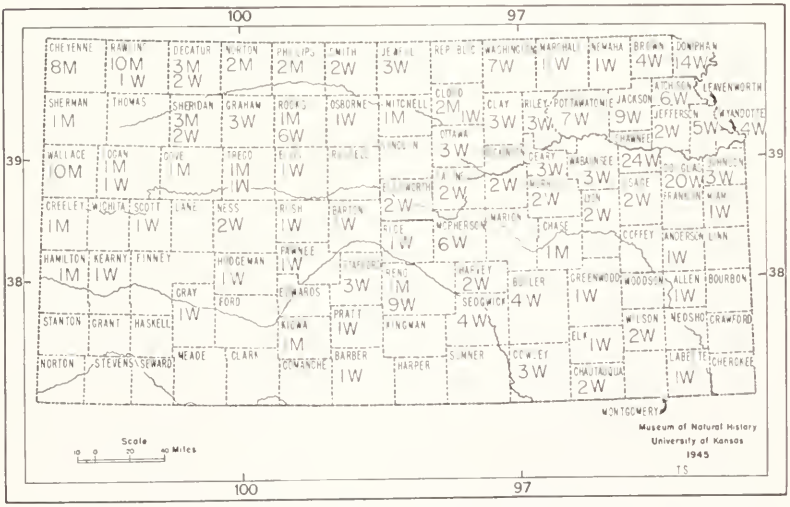
Map 5. Distribution of mule deer and white-tailed deer as reported by County Agricultural Agents.



Map 6. Distribution of mule deer and white-tailed deer as reported by Work Unit Conservationists.



MAP 7. Distribution of mule deer and white-tailed deer as reported by State Game Protectors.



MAP 8. Numbers of mule deer (M) and white-tailed deer (W) accidentally or illegally killed in each county from April, 1962, to February, 1963, as reported by State Game Protectors.

The numbers of deer that died from various causes are listed in Table 8, and the numbers of deer killed in each county are shown on Map 8. Only three deaths were attributed to animals. Dogs, coyotes, and possibly bobcats are the only known predators of deer in Kansas. However, I know of no actual observation of a predator killing a deer in Kansas. Deaths investigated by Game Protectors were blamed on animals by such evidence as footprints and partially eaten carcasses. Dogs have been observed chasing deer and may be indirectly responsible for their death by running them into fences or into the path of vehicles. Gier (1957) did not mention deer remains in stomachs of 1190 coyotes killed in Kansas. Predators probably do not pose a serious problem in limiting population increases; however, they may be responsible for many more deaths, especially of fawns, than are brought to man's attention.

Fifty-one mule deer were killed in 19 counties and 222 white-tailed deer were killed in 64 counties; ten were not identified as to species. Both kinds of deer were killed in nine counties. Most of

Table 8. Numbers of Deer that Died From Various Causes as Reported by Kansas State Game Protectors From April, 1962, to February, 1963.

Vehicles	231	Food poisoning	1
Shot illegally	21	Predation	3
Trains	3	Mowing machines	2
Falls	1	Plate glass window	1
Fences	3	Unknown	17

the mule deer that were killed were in northwestern Kansas, although one was in Chase County in east-central Kansas. Most white-tailed deer were killed in northeastern Kansas, but Rawlins, Kearny, and Logan counties in western Kansas each were represented by one kill of this species.

Deer killed, from all causes, by month from April, 1962, to February, 1963, are shown in Table 9. Most mortalities occurred in May and November when 48 and 68 deaths, respectively, were reported. Mortalities increased from April to May, decreased from May to July, increased from August to November, and decreased from November to February.

The rutting season is probably responsible for the sharp increase in kills in November as deer move about more at that time. Almost twice as many males as females were killed in November. In May, three more females than males were killed. Erickson, *et al.* (1961) listed the following possible reasons why road-kills increase in Minnesota in May and June: herbaceous food plants growing along

roadsides attract deer; does are leading fawns about; deer seek openings to avoid insects; and as the days grow longer more motorists drive in the evening hours.

Table 10 shows the number of deer mortalities by sex and age class. Almost 58 per cent were adults, 28 per cent were yearlings, and 10 per cent were fawns; 5 per cent were not aged.

TABLE 9. DEER KILLED, FROM ALL CAUSES, BY MONTH BY SEX FROM APRIL, 1962, TO FEBRUARY, 1963, AS REPORTED BY KANSAS STATE GAME PROTECTORS.

	Female	Male	Sex?	Total		Female	Male	Sex?	Total
April	12	8	0	20	Oct.	20	15	0	35
May	24	21	3	48	Nov.	24	42	2	68
June	9	8	1	18	Dec.	7	7	2	16
July	6	6	0	12	Jan.	10	6	0	16
Aug.	7	5	0	12	Feb.	5	5	0	10
Sept.	12	8	0	20					

TABLE 10. SEX AND AGE OF DEER KILLED IN KANSAS FROM APRIL, 1962, TO FEBRUARY, 1963, AS REPORTED BY KANSAS STATE GAME PROTECTORS.

	Females	Males	Total
Adults	74	90	164
Yearlings	46	32	78
Fawns	17	10	27
Unclassified			14
Total	137	132	283

WHITE-TAILED DEER IN NORTHEASTERN KANSAS

DESCRIPTION

Deer of the genus *Odocoileus* are even-toed ungulates and ruminants belonging to the family Cervidae that can be characterized as follows:

Size medium; antlers present only in males, large and forked; face long and narrow; ears variable in size and hairiness; tail long or of average length; coat unspotted in adults; tarsal and metatarsal glands present, along with interdigital gland; lacrimal pits and preorbital glands small; upper canines and incisors absent; young spotted.

The differences in external physical characteristics between the white-tailed deer and the mule deer are sufficient for distinguishing the two species. The mule deer averages slightly larger. Its tail

is tipped with black and is white or brown elsewhere, the ears are approximately two-thirds the length of the head, antlers of males branch dichotomously, and the metatarsal gland is more than 25 mm. in length. In the white-tailed deer the tail is longer than in the mule deer, brown above, white below, and fringed with white around the edges. The ears are approximately half the length of the head, the antlers have vertical prongs arising from a main beam, and the metatarsal gland is less thn 25 mm. in length.

Size

Weight.—Weights of Kansas white-tailed deer estimated by State Game Protectors range from 90 to 350 pounds for adults, 60 to 175 for yearlings, and 10 to 100 pounds for fawns. Table 11 shows the extremes in weight and the average weight for each age class by sex for white-tailed deer as compared with mule deer. For purposes of classification, deer less than one year old are listed as fawns, those between one and two years old as yearlings, and deer two years old or older as adults.

White-tailed deer in Kansas grow rapidly, weighing 100 pounds or more when 10 to 11 months old. Large fawns may be mistaken easily for adults by the casual observer. In the field, examination of the teeth is the best method for determining age. Yearlings, 17 to 18 months old, may weigh 175 pounds or more. Table 12 shows actual and estimated weights of 12 Kansas whitetails by sex and age.

External measurements.—Measurements, taken by me, of a male 18 months old, a male 11 months old, a male 8 months old, and a female 11 months old are, respectively, as follows: Total length, 1880, 1837, 1764, 1651 millimeters; length of tail, 300, 294, 269, 234; length of hind foot, 490, 466, 441, 453; length of ear from notch, 150, 159, 147, 150.

Measurements of the skull.—Measurements were taken of 30 skulls in the Museum of Natural History. Five subspecies of *Odocoileus virginianus* were represented and included the following: *borealis* (3), *dacotensis* (3), *texanus* (4), *virginianus* (1), and *macrourus* (19). Seventeen skulls were from Kansan deer, one *virginianus* and the rest *macrourus*. The largest skull of an adult male of *macrourus* had the following measurements: Condylobasal length, 294 mm.; zygomatic width, 115; interorbital breadth, 73.7; length of maxillary tooth-row, 86.0. Corresponding measurements of the largest skull of an adult female *macrourus* were as follows: 277, 110.6, 65.0, 80.1.

In general, the skulls of *O. v. macrourus* examined were smaller than skulls of *borealis*, but larger than those of *dacotensis*, *texanus*, and *virginianus*. It is impossible to identify subspecies accurately on the basis of cranial characters alone. Table 13 shows individual, secondary sexual, and age variation in skulls of 17 white-tailed deer from northeastern Kansas.

TABLE 11. LIVE WEIGHTS OF DEER KILLED IN KANSAS FROM APRIL, 1962, TO FEBRUARY, 1963, AS ESTIMATED BY STATE GAME PROTECTORS (AGE ALSO IS AN ESTIMATE BY GAME PROTECTORS).

Age and Sex	White-tailed Deer			Mule Deer		
	Number	Weight extremes	Average weight	Number	Weight extremes	Average weight
Adult Bucks	72	90–350	207	13	125–275	195
Adult Does	55	90–300	156	16	100–300	168
Yearling Bucks	23	80–175	116	6	95–140	118
Yearling Does	38	60–160	99	6	80–150	111
Male Fawns	8	10–100	51	1	80	
Female Fawns	9	35–100	61	7	10–80	49

TABLE 12. WEIGHTS (ACTUAL OR ESTIMATED), AGE, AND SEX OF 12 KANSAS WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS MACROURUS*).

Sex	Age in months	Weight in pounds
♀	4	70*
♀	10	120
♀**	10–11	105
♀	10–11	100*
♀**	11	145*
♀	17	125
♀**	23–24	150*
♂	8	100
♂	11	140
♂	17	180*
♂	17–18	174
♂	23–24	200

* Indicates estimate of weight.
** Indicates pregnant doe.

Coloration

Winter pelage.—Four skins (KU 89196, 89197, 89963, 89969) of *Odocoileus virginianus macrourus* from Kansas were available for examination. Two of these, one of each sex that was approximately 17-18 months old, were killed in November, 1961. These two were in prime winter pelage as evidenced by the longer and denser hair and less reddish color of the dorsal pelage, than deer in summer pelage. In the male, the overall color of the dorsum, sides, neck, and flanks is dark cinnamon brown, becoming buffy adjacent to the pure white hair on the venter and on the insides of the upper legs. The lateral or more exposed areas of the legs are pale brown to pale buff. The tail is cinnamon dorsally, fringed with white, and is white ventrally. The face has a grayish grizzled pattern except for a ring around the eyes of gray hairs

Table 13. Variation in Cranial Measurements by Sex and Age of White-tailed Deer From Northeastern Kansas (Figures Within Parentheses Are Averages).

Sex	Age (months)	Number measured	Condylobasal length	Zygomatic breadth	Interorbital breadth
♂	6	1	243	105	57
♀	10–11	5	237–251 (242)	97–103 (100)	53–59 (56)
♂	9–11	3	242–251 (247)	100–103 (101)	54–59 (56)
♂	17–18	2	278–287 (283)	116–120 (118)	68–73 (70)
♀	24–30	2	262–269 (265)	106–107 (106.5)	61–65 (63)
♂	24	1	294	115	74
♀	36	2	263–277 (270)	106–111 (108.5)	60–65 (63)
♂	48	1	254	115	65

tipped with white and a band of pale buff immediately behind the nose pad. A whitish-gray patch composed of gray hair with white tips is present on the throat and underside of the jaw. The black-tipped hairs having a subterminal band of pale buff followed by second band of cinnamon brown, and that are white basally, give a slight grizzled appearance to the dorsum, sides, and neck.

The November-taken female is slightly darker dorsally and the face is less grizzled than in the male; the throat patch is buffy instead of gray.

Another female, 10 to 11 months old, killed on April 23, 1962, still carried most of her winter coat. Small patches of the reddish brown summer coat were visible on the dorsum and sides where the winter coat was being shed. The winter coat had faded from the dark cinnamon found in the November-taken deer to a grayish brown, which was darker on the dorsum than on the sides. The venter, the insides of the legs, and the ventral side of the tail were yellowish. The throat patch was gray and the tail was dark brown dorsally. The old winter hair was brittle and broke easily when bent. Also, it was not so glossy or smooth as in early winter coats or as new summer hair just coming in. The summer hair was less than one inch in length and was thinner than the winter hair.

One deer of the subspecies *O. v. texanus* (KU 84921), killed in Texas in December, was compared with the November-taken deer described above. In the Texas specimen the dorsum, sides, and flanks were gray to grayish brown, becoming brownish gray on the legs. The facial pattern was the same, but the cheeks were pale gray instead of pale brown as in *macrourus*. The hair of *macrourus* is more than twice the length of the hair of *texanus*.

Summer Pelage.—An adult male, killed on May 22, 1962, had shed its winter coat except for several patches. The summer coat is dark reddish

brown on the dorsum and upper sides, and dorsum of the tail, and paler near the venter. The legs are the same color as those of the winter coat. The top of the head is reddish brown, and the cheeks pale brown. A band of dark brown hair on the rostrum becomes wider nearer the eyes. The tail is fringed with white dorsally and is white ventrally. The venter and throat patch are white except where the yellowish winter hair still is present. In comparison with a specimen of *Odocoileus virginianus dacotensis* taken in July in South Dakota (KU 87115), *O. v. macrourus* is slightly darker and more reddish on the dorsum and sides, but the rest of the coat closely resembles that of *dacotensis*.

Judging from the specimens examined, *Odocoileus virginianus* in Kansas has a well-developed winter coat by the middle of November. This coat is retained at least partially into April of the following year. In the latter part of April, the winter hair has been replaced by the summer hair except for a few small scattered patches. More specimens need to be collected to show individual age and secondary sexual variation in deer of Kansas.

STATUS IN DOUGLAS COUNTY

The white-tailed deer occurs primarily in woodland areas and nearly every individual spends at least several hours, usually most of the time, in timber. McGregor (1948) reported that woodlands of Douglas County consisted of three types: oak-hickory, mixed woodland, and willow-cottonwood. White-tailed deer occur in each of these types of woodland.

The oak-hickory association is the most common and is found on the more or less undisturbed hilltops and hillsides. The dominant trees are oak and hickory.

The mixed woodland association occurs in disturbed areas that have been cut over or burned, and along small streams. This type of woodland is slowly replaced by the oak-hickory association in undisturbed areas. The dominant tree of the mixed woodland is the American elm.

The willow and cottonwood association occurs in many places along the Kansas River. In some places willows occur in solid stands, in other places cottonwoods are found in solid stands, and in still other places the two kinds of trees occur together. Above the normal flood plain, they occur along with elm, ash, maple, and other trees.

Figures obtained from the U. S. Soil Conservation Service, Lawrence, Kansas, show that there were 24,871 acres of woodland in Douglas County as of June 1962. This is approximately 9 per cent of the total acreage, which includes 170,996 acres of cropland, 74,050 acres of pastureland, and 4,014 acres of urban and related areas.

According to local residents, deer were rare in the county 10 years ago, and probably moved in from the north and east; the earliest observations were in that part of the county.

At present (1963), white-tailed deer occur throughout Douglas County. Heaviest concentrations appear to be in the northwestern part of the county, judging from the relative abundance of sign. Many residents of that area reported seeing several groups of five and six deer. Late in the winter of 1963, Mrs. William Hess, RFD 1, reported that she saw a herd of more than 20 deer about one mile south of Kanwaka. Deer sign also was abundant in the southwestern part of the county, near Baldwin. Eddie Bond, State Game Protector, reported seeing 23 deer in one herd two miles north of Baldwin in the spring of 1963.

Aerial counts, group pellet counts, road track counts, and deer drives are some of the methods that have been used in other states in attempts to determine the size of deer herds. Actually, no accurate method has been devised; nevertheless, deer drives, when conducted properly, probably would be best suited in Kansas for determining the number of deer present in small areas of one or two square miles. Deer drives usually require a large number of men and therefore are expensive. The small patches of timber in Douglas County would allow observers to be placed at strategic points to count any deer that ran out of the timber. This would decrease the number of men needed in the driving line as the area driven would not have to be completely surrounded. A line of 15 men spaced about 40 yards apart should be sufficient to drive any body of timber in Douglas County. Another five or six men would be needed around the sides of the area to count deer flushed into the open.

Aerial censusing often is used in mountainous terrain and open range, and probably would prove satisfactory in western Kansas. Between 11:00 a. m. and noon in January of 1963, I attempted an aerial survey of two areas in Douglas County known to contain deer. The areas were (1) the Natural History Reservation, four miles north and one and one-half miles east of Lawrence, and (2) the Kansas River Bottom from Eudora to Lecompton. Three and one-half inches of snow covered the ground and the temperature was near zero. No deer were sighted, probably because they had sought shelter from the cold in the dense stands of timber. Dense timber would reduce the effectiveness of airplane counts in eastern Kansas.

The number of 100 to 200 deer in Douglas County as derived from the questionnaires seems to me to be conservative. I estimated 400 deer in Douglas County in January of 1963. This estimate was based on relative abundance of sign in different areas and observations of deer by local residents.

In talking with rural residents of Douglas County about deer, I found that all were inclined favorably toward the animal. When local residents were asked if they thought enough deer were present to warrant a hunting season, most did not, but many felt that a season would be necessary if the numbers of deer continued to increase.

Over-browsing, over-population, and diseases were not found and seem not to be limiting the increase of deer in the county at present. However, a close check on range conditions and population trends should be maintained in order to harvest a part of the annual increase at an appropriate time and so prevent the population from exceeding the range capacity.

Food Habits

Deer utilize a great variety of plants, browsing on twigs, buds, leaves, fruits, and stems of trees, shrubs, broad-leafed herbaceous plants, and grasses. Atwood (1941) listed 614 species of plants known to be eaten by the white-tailed deer in the United States. Korschgen (1954) listed more than 200 kinds of plants taken from 440 stomachs of Missouri deer over a five-year period.

In agricultural areas deer feed on almost any crop available, including truck crops and fruit trees. But, so long as populations remain at a level at which native habitat can support them, crop damage tends to be minor. A thorough study revealing which plants are preferred foods in Kansas has yet to be made. The material that follows is merely some data. These data on plants eaten by white-tailed deer in Kansas were obtained by observing sign and by analysis of rumen contents.

Stomach contents of nine deer were collected from November 14, 1961, to January 26, 1963. Three stomachs were collected in November and three in May, two in April, and one in January. All deer were killed in Douglas, Leavenworth, and Wyandotte counties. The rumen samples were preserved in a 10 per cent formalin solution and approximately one pint from each sample was examined. The samples were washed on consecutive one-quarter, one-eighth, and one-sixteenth inch screens to facilitate separation and identifi-

cation of plants. The plant material was then placed on an enamel tray and air-dried. After drying, identifiable portions were removed and placed in vials to be identified later. Plants were identified with the help of Dr. R. L. McGregor, Department of Botany, University of Kansas. Plant classification follows that in *Gray's Manual of Botany,* Eighth Edition (Fernald, 1950). I measured the volume of identified plants and apportioned the remainder by ocular estimate and on the basis of volume of identified items. Percentages by volume were obtained by dividing the total volume of a specific food item by the total volume of all samples.

Analysis of the stomach contents showed 35 identified food items. Many plants, including grasses and leaves of some shrubs, could not be identified because mastication resulted in the loss of diagnostic characters. Table 14 shows the number of occurrences and the percentage by volume for each food item. "Trace" was entered in the table for each food item that comprised less than one-tenth of one per cent of the total volume. Patterns of plant utilization by season could not be determined from nine stomachs.

Grasses made up the largest percentage (12.8%) of native forage and occurred in seven of the nine stomachs. The largest volume of grass (78%) was found in deer killed in spring. Fifteen kinds of woody plants were identified and comprised 18.2 per cent of the total volume. Broad-leafed herbaceous plants, fungi, and aquatic plants made up 6.1 per cent of the total volume.

Field observations showed extensive though not heavy utilization of dogwood (twigs and leaves), mushrooms, willow (twigs and leaves), buckbrush, ragweed, and mule's tail.

Korschgen (1954) reported that oak mast was the principal source of food for deer in Missouri. I did not find oak mast present in stomach contents examined, although various species of oaks occur throughout the areas in which the deer were killed. Korschgen also reported that a decrease in oak mast production resulted in an increase in utilization of agricultural crops.

Grain of sorghum and corn, and stems and leaves of soy-bean were identified in the stomachs examined. Corn and sorghums made up 53 per cent of the total volume. Lespedeza and clover were found in "trace" amounts. Although commonly grown as feed for livestock, lespedeza and clover also grow extensively under natural conditions.

In the field I noticed at one time or another places where deer had fed on wheat, sorghum, corn, soy-bean, and alfalfa. In no case was the damage severe. Most evidence of feeding activity

TABLE 14. PLANTS IDENTIFIED FROM STOMACHS OF NINE WHITE-TAILED DEER IN KANSAS.

Food item and parts eaten	Number of occurrences	Per cent by volume
Sorghum (*Sorgum vulgare*) grain	2	27.6
Corn (*Zea Mays*) grain	3	25.4
Grasses (unclassified) plant	7	12.8
Smooth sumac (*Rhus glabra*) seed	2	7.7
Cottonwood (*Populus deltoides*) leaves	2	3.0
Fragrant sumac (*Rhus aromatica*) plant	1	2.1
Honey-Locust (*Gleditsia triacanthos*) seed-pods	4	1.7
Horse-nettle (*Solanum carolinense*) seed	2	1.7
Morning-glory (*Ipomoea hederacea*) plant	1	1.5
Black Oak (*Quercus velutina*) leaves	1	1.5
Dogwood (*Cornus* sp.) plant	3	1.5
Lamb's quarters (*Chenopodium hybridum*) leaves	1	1.2
Smartweed (*Polygonum* sp.) seed	1	0.9
Fungus (*Geaster* sp.) plant	1	0.9
Tick-trefoils (*Desmodium* sp.) seed	2	0.4
Ash (*Fraxinus* sp.) plant	1	0.4
Sunflower (*Helianthus* sp.) seed	1	0.4
Kentucky Coffee-tree (*Gymnocladus dioica*) seed	1	0.3
Pondweed (*Potamogeton* sp.) seed	1	0.2
Lespedeza (*Lespedeza* sp.) plant	1	trace
Clover (*Trifolium* sp.) plant	1	trace
American Elm (*Ulmus americana*) leaves	1	trace
Switchgrass (*Panicum virgatum*) seed	1	trace
Willow (*Salix interior*) plant	1	trace
Pinkweed (*Polygonum pennsylvanicum*) seed	1	trace
Tall Red-top (*Triodia flava*) plant	1	trace
Red Cedar (*Juniperus virginiana*) buds	1	trace
Mulberry (*Morus* sp.) buds	1	trace
Hazelnut (*Corylus americana*) buds	1	trace
Beard-Tongue (*Penstemon* sp.) seed	1	trace
Panic-Grass (*Panicum* sp.) seed	1	trace
Soy-Bean (*Glycine Max*) plant	1	trace
Sedge (*Carex* sp.) seed	1	trace
Broad-leafed shrub (unclassified) leaves	1	trace
Legume (unclassified) seed	1	trace
Unidentified plant material	9	8.8
Total		100.0%

was concentrated at the edges of fields adjacent to wooded areas.

In agricultural areas such as Kansas, cultivated crops may form an important part of the diet of deer. Crop damage at present does not seem to be great. Only nine reports of crop damage were reported in the questionnaire mentioned previously. Most of these complaints involved damage to corn, grain sorghum, soy-bean and, in one instance, a fruit orchard.

As the population of deer in Kansas continues to increase, crop damage probably will become more apparent as the availability of natural food decreases. Analysis of rumen contents would show if

the utilization of cultivated plants is increasing from year to year.

In proper management, it is essential that a deer herd be kept in balance with its food supply. To accomplish this the principal foods utilized by deer must be determined, as well as the main browse species, so that they can be used as indicators of the carrying capacity of the range.

Probably the most accurate method of determining the principal foods is by analysis of rumen contents. Plant material in deer stomachs can be identified and its volume measured. Because deer eat a great variety of plants, a large number of stomachs must be examined to determine what plants are most heavily utilized. Also, since availability of many plants changes by season, deer stomachs should be obtained in each month of the year.

Trends in range condition can be determined by comparing increases or decreases of certain plants that deer utilize from year to year. For example, in Missouri, Korschgen (1954) reported that red cedar and oak leaves were poor browse species and were considered close to a starvation diet. An increase of these two species in the diet of deer would indicate deterioration in range conditions resulting from over-population or other factors. Plants that show trends in range conditions or range carrying-capacity are called indicators. Indicator plants should be those that have a wide distribution and are most utilized as browse. Korschgen (*op. cit.*) reports that Coralberry, the sumacs, Red Cedar, and wild grapes may serve as the principal indicators of range carrying-capacity in Missouri. When deterioration of range conditions is evident, steps must be taken to reduce the deer herd, usually by hunting.

Reproduction

An adult white-tailed doe usually bears one fawn or twins. Triplets are less common; quadruplets have been recorded. According to Severinghaus and Cheatum (*in* Taylor, 1956:95), well-nourished doe fawns, at least in the white-tailed deer of the northern woodlands, breed when six to eight months old. A doe breeding at an early age usually gives birth to a single fawn; rarely are there twins or triplets. Each of two pregnant does from Leavenworth County, Kansas, that I examined, was 10 to 11 months old and carried a single fetus at the time of death. According to the age of the fetuses, these does bred when about six months old. A third doe from Leavenworth County that was 23-24 months old carried twins. Mortality reports of State Game Protectors revealed 13 pregnant

does, of which six were carrying single embryos, six had twins, and one had triplets; the 13 females were carrying 21 fetuses for an average of 1.61 per doe. Cheatum and Severinghaus (1950) found a direct correlation between range condition and fertility of does in New York State. They reported does one and a half years old or older averaged 1.71 embryos in the best western range and 1.06 embryos in the poorest central Adirondack range. The average of 1.61 fetuses per doe in 13 pregnant females from Kansas indicates a high rate of fertility, which may be correlated with good quality of range. Of course 13 is too small a number to yield a statistically reliable average.

By knowing the length of gestation and the age of the fetus, one can determine with a fair degree of accuracy both the date of conception and the projected date of birth. Severinghaus and Cheatum (*in* Taylor, 1956:62) report that gestation periods ranging from 189 to 222 days have been observed in white-tailed deer. Twenty-one records of whitetails reported by various authors yield an average gestation period of 199.4 days. I obtained measurements of five fetuses from three does (two with a single fetus and one with triplets). The fetuses were aged according to size and physical characteristics on the basis of Armstrong's (1950) work on fetal development. One fetus was about 125 days old, another was about 148 days old. The triplets, one male and two females, were approximately 90 days old. The 125-day old fetus was killed on April 23, 1962, and would have been born sometime around July 7. The 148-day old fetus was killed on May 5, 1962, and would have been born around June 26. The triplets were killed on February 6, 1963, and would have been born around May 26. The approximate dates on which these fetuses were conceived, therefore, are December 20, December 9, and November 8, respectively.

Although the above information gives some indication as to when mating and fawning occur, it does not indicate when peaks of the rutting and fawning seasons are reached.

In other states the sharp increase of road-kills in autumn is correlated with the breeding season, a time when deer move about more than in other seasons. In Kansas the incidence of road-kills is highest in November, probably because this is the rutting season. If the gestation period is approximately 200 days, then the peak of the fawning season should occur in the latter part of May and

the first part of June. Determination of age of more embryos from does killed in Kansas will probably show that most fawns are born at this time.

Parasites

Three white-tailed deer were examined for external parasites and six for internal parasites. I was not able to examine any of these individuals until several hours after death. Visceral organs examined included the heart, liver, lungs, stomach, and intestines. These were opened and washed over a fine screen, but no parasites were found. All of the organs examined appeared to be in good condition as no lesions or discolorations of the tissues were noted. Neither were external parasites found on the specimens examined (but some external parasites may have dropped off the carcasses as they lost body heat prior to my examination). Anderson (1962: 162) indicated that about 66 different organisms parasitize the white-tailed deer and the reader is referred to his work for detailed information.

Many parasites of deer are limited in their distribution to certain areas of North America by factors such as climate, topography, soil characteristics, and distribution of intermediate hosts and reservoir hosts. Soil conditions or climate, for example, may not be suitable for the hatching of eggs or larval development. Topography may limit the distribution of intermediate hosts such as certain snails that are necessary in completing life cycles of some trematodes. Reservoir hosts such as cattle may be absent in some areas locally and as a result a parasite common to both cattle and deer in an area nearby will not be found in or on deer occupying an area lacking cattle.

Although no parasites were found in deer that I examined, examination of a larger number would be expected to reveal some parasites, especially if the population of deer becomes dense. However further investigation probably would show also that the incidence of parasites is low in Kansas deer. Van Volkenberg and Nicholson (1943:220-223) reported that poor food supplies tended to increase parasitism, especially on ranges where livestock was plentiful, but that deer having a good diet of browse were less likely to have heavy infestations of parasites. I have found no evidence of overbrowsing in any of the areas that I examined, indicating, at least in these areas, that deer have a good food supply. Severinghaus and Cheatum (*in* Taylor, 1956:170-171) reported that incidence of parasitic infections may increase where concentrations of deer are

heavy, as in "wintering yards," because the chances of ingesting eggs or larvae are increased. Although groups of 30 or more deer have been observed by residents in Kansas, deer are not restricted to small areas by heavy snowfalls as they are in some northern states, and transmission of some parasities may, therefore, be relatively low.

CONCLUSIONS AND RECOMMENDATIONS

When white men first reached Kansas, mule deer occurred in the western part of the state and white-tailed deer occurred in the eastern part and along streams farther west. The original subspecies of the white-tailed deer in Kansas probably were *Odocoileus virginianus macrourus* and *O. v. texanus*. Introductions of deer possibly resulted in crosses between two or more subspecies.

Today, mule deer occur at least as far east as Cloud and Republic counties in north-central Kansas, and Chase County in east-central Kansas. White-tailed deer occur in most areas of the state, but are most abundant in the eastern half.

On the basis of questionnaires to selected observers, I estimate that Kansas had no fewer than 12,000 deer in 1962.

Deer occur in all counties of Kansas, with the possible exception of Stanton County, and they are increasing in most areas of the state. From areas having large populations of deer, the populations are expanding toward the interior of the state. Deer populations are increasing more slowly in the southwestern counties than elsewhere. The rate of population increase seems to have remained at about the same level over the past four years. Most deer inhabit river bottoms or creek bottoms but some occur in upland timber, brushland, and grassland.

At present, deer in Kansas are healthy and no evidence was found of deaths from parasites, disease, or lack of food.

Deer in Kansas weigh about 100 pounds when one year old, and some female white-tailed deer in Kansas breed when six to eight months old.

Any increase in crop damage in various areas within the state justifies intensive studies designed to reveal how many deer can reasonably be supported in those areas. Carrying-capacity of deer range in Kansas needs to be determined as well as the number of deer present. Knowledge of the rate of increase in populations of deer can be obtained by annual censuses in given areas in successive years and will help to indicate when the maximum carrying-capacity of the deer range will be reached.

ACKNOWLEDGMENTS

I am grateful to Drs. E. Raymond Hall and J. Knox Jones, Jr. for their advice and counsel, to Dr. A. Byron Leonard for assistance with the illustrations and to Dr. Ronald L. McGregor for identifying plants. Thanks are extended to Kansas State Game Protectors Eddie Bond and E. L. Bryan for providing specimens in the course of my study, and for their interest and encouragement. Thomas H. Swearingen made parts of the maps. Thanks are extended also to Mr. Dave Coleman, Chief of the Game Division, and Mr. William Peabody, Game Biologist, of the Kansas Forestry, Fish and Game Commission, for allowing me to examine information in their files. I am indebted also to those persons who answered my questionnaire. A Teaching Assistantship in Zoology at the University of Kansas in two semesters and a Research Assistantship on the State Biological Survey of Kansas in the terminal semester of my study provided essential financial support.

LITERATURE CITED

Allen, J. A.
1874. Notes on the mammals of portions of Kansas, Colorado, Wyoming and Utah. Bull. Essex Institute, Salem, Mass., 6:43-52.

Allen, P. B.
1940. Kansas mammals. Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):1-62.

Anderson, R. C.
1962. The parasites of white-tailed deer. Proc. First Nat'l White-tailed Deer Disease Symposium. Univ. Georgia Center for Continuing Education, Athens, Georgia, pp. 162-173.

Armstrong, R. A.
1950. Fetal development of the northern white-tailed deer (*Odocoileus virginianus borealis* Miller). Amer. Midland Nat., 43(3):650-666.

Atwood, E. L.
1941. White-tailed deer foods of the United States. Journ. Wildlife Mgt., 5(3):314-332.

Baker, A. B.
1889. Mammals of western Kansas. Trans. Kansas Acad. Sci., 11:56-58.

Black, J. D.
1937. Mammals of Kansas. Kansas State Board Agric., 30th Biennial Report, 35:116-217.

Cheatum, E. L. and Severinghaus, C. W.
1950. Variations in fertility of white-tailed deer related to range conditions. Trans. Fifteenth N. Amer. Wildlife Conf., pp. 170-190.

Cockrum, E. L.
1952. Mammals of Kansas. Univ. Kansas Publ., Mus. Nat. Hist., 7:1-303, 37 figs.

Erickson, A. B., Gunvalson, V. E., Stenlund, M. H., Burcalow, D. W., and Blankenship, L. H.
1961. The white-tailed deer of Minnesota. Minnesota Department of Conservation, Tech. Bull. No. 5, pp. viii + 64, illust.

Fernald, M. L.
1950. Gray's manual of Botany, 8th ed., American Book Company, New York. 1,632 pp.

Gier, H. T.
1957. Coyotes in Kansas. Kansas Agric. Exp. Station Bull. 393, 97 pp., 32 figs., 14 tables.

Hibbard, C. W.
1933. A revised checklist of Kansas mammals. Trans. Kansas Acad. Sci., 36(3):230-249.
1944. A checklist of Kansas mammals, 1943. Trans. Kansas Acad. Sci., 47:61-88.

Knox, M. V. B.
1875. Kansas mammalia. Trans. Kansas Acad. Sci., 4:19-22.

Korschgen, L. J.
1954. A study of the food habits of Missouri deer. Missouri Conservation Commission, Pittman-Robertson Series, pp. iv + 44, 1 fig., 17 tables.

Lantz, D. E.
1905A. Kansas mammals in their relation to agriculture. Kansas State College Exp. Sta. Bull., 129:331-404.
1905B. A list of Kansas mammals. Trans. Kansas Acad. Sci., 19:171-178.

McGregor, R. L.
1948. The flora of Douglas County, Kansas. Trans. Kansas Acad. Sci., 51:77-106.

Mead, J. R.
1899. Some natural history notes of 1859. Trans. Kansas Acad. Sci., 16:280-281.

Phillips, W. A.
1890. Kansas history. Trans. Kansas Historical Soc., 4:351-359.

Taylor, D. L. and Elder, J. B.
1959. A preliminary survey of deer in Kansas. Trans. Kansas Acad. Sci., 62:67-79, 4 figs., 6 tables.

Taylor, W. P. (ed.)
1956. The deer of North America. Washington, D. C. and Harrisburg, Penn.; The Wildlife Management Institute, and The Stackpole Company, pp. xx + 668, Col. frontispiece, illustrated.

Thwaites, R. G. (ed.)
1905. Early western travels, 1748-1846. The Arthur H. Clark Company, Cleveland, Ohio, 14:1-321.

Thien, J. A., and Sprague, J. M.
1939. Amphibians, reptiles and mammals of the Meade County State Park. Trans. Kansas Acad. Sci., 42:499-512.

Van Volkenberg, H. L., and Nicholson, A. J.
1943. Parasitism and malnutrition of deer in Texas. Journ. Wildlife Mgt., 7:220-223.

Transmitted July 8, 1964.

□

30-3969

Institutional libraries interested in publications exchange may obtain this series by addressing the Exchange Librarian, University of Kansas, Lawrence, Kansas.

Requests of individuals are handled instead by the Museum of Natural History, The University of Kansas, Lawrence, Kansas. There is no provision for sale of this series either by the Library or the Museum. However, when individuals request copies from the Museum, the amount indicated below should be included for the purpose of defraying some of the costs of producing, wrapping and mailing.

Nos. 6, 12, 17, 27, 36, 37 and 38 obtainable only from the Arctic Institute.

° 1. The Museum of Natural History, the University of Kansas. By E. R. Hall and Ann Murray. Pp. 1-16, illustrated. January 5, 1946.

° 2. Handbook of amphibians and reptiles of Kansas. By Hobart M. Smith. Pp. 1-336, 233 figures in text. September 12, 1950.

° 3. In memoriam, Charles Dean Bunker, 1870-1948. By E. Raymond Hall. Pp. 1-11, 1 figure in text. December 15, 1951.

° 4. The University of Kansas, Natural History Reservation. By Henry S. Fitch. Pp. 1-38, 4 plates, 3 figures in text. February 20, 1952.

° 5. Prairie chickens in Kansas. By Maurice F. Baker. Pp. 1-68, 4 plates, 15 figures in text. March 10, 1953.

6. The barren ground caribou of Keewatin. By Francis Harper. Pp. 1-163, 28 figures. October 21, 1955. Copies, paperbound, $1.50 postpaid from the Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, D. C. 20009.

7. Handbook of mammals of Kansas. By E. Raymond Hall. Pp. 1-303, illustrated. December 13, 1955. Paperbound, $1.50 postpaid.

8. Mammals of northern Alaska, on the arctic slope. By James W. Bee and E. Raymond Hall. Pp. 1-309, frontispiece colored, 4 plates, 127 figures in text. March 10, 1956. Paperbound, $1.00 postpaid.

9. Handbook of amphibians and reptiles of Kansas. 2nd [revised] edition. By Hobart M. Smith. Pp. 1-356, 253 figures in text. April 20, 1956. Paperbound, $1.50 postpaid (cloth $4.00).

° 10. The raccoon in Kansas. By Howard J. Stains. Pp. 1-76, 4 plates, 14 figures in text. July 6, 1956.

° 11. The tree squirrels of Kansas. By Robert L. Packard. Pp. 1-67, 2 plates, 10 figures in text. August 20, 1956.

12. The mammals of Keewatin. By Francis Harper. Pp. 1-94, 6 plates, 8 figures in text, 1 map. October 26, 1956. Copies, paperbound, 75 cents postpaid from the Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, D. C. 20009.

° 13. Museum of Natural History . . . University of Kansas. By Roy R. Moore and E. R. Hall. [An unpaged, illustrated "flier," 14½ in. x 8½ in., printed on both sides, and folded twice.] June 1, 1957.

14. Vernacular names for North American mammals north of Mexico. By E. Raymond Hall, Sydney Anderson, J. Knox Jones, Jr., and Robert L. Packard. Pp. 1-16. June 19, 1957.

° 15. The ecology of bobwhites in south-central Kansas. By Thane S. Robinson. Pp. 1-84, 2 plates, 11 figures in text. September 6, 1957.

° 16. Natural history of the prairie dog in Kansas. By Ronald E. Smith. Pp. 1-36, 4 plates, 9 figures in text. June 17, 1958.

17. Birds of the Ungava Peninsula. By Francis Harper. Pp. 1-171, 6 plates, 26 figures in text. October 15, 1958. Copies, paperbound, $2.00 postpaid from the Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, D. C. 20009.

18. Furbearers in Kansas: A guide to trapping. By Howard J. Stains and Rollin H. Baker. Pp. 1-100, 2 plates, 13 figures in text. November 19, 1958. Paperbound, 50 cents postpaid.

° 19. Natural History Museum. By Roy R. Moore and E. R. Hall. [An unpaged, illustrated "flier," 14½ in. x 8½ in., printed on both sides, and folded twice.] May 29, 1959.

20. Handbook of gastropods in Kansas. By A. Byron Leonard. Pp. 1-224, plates 1-11, 87 figures in text. November 2, 1959. Paperbound, $1.00 (cloth $2.00) postpaid.

21. Management of channel catfish in Kansas. By Jackson Davis. Pp. 1-56, 8 figures in text. November 2, 1959.

22. Hand-list of the birds of Kansas. By Richard F. Johnston. Pp. 1-6 [folded twice]. May 7, 1960.

° 23. Directory to the bird-life of Kansas. By Richard F. Johnston. Pp. 1-69, 1 figure in text. August 31, 1960.

° 24. Natural History Museum. By Roy R. Moore and E. R. Hall. [An unpaged, illustrated "flier," 14½ in. x 8½ in., printed on both sides, and folded twice.] October 19, 1960.

25. Guide to the panorama of North American mammals. By E. Raymond Hall, *et al.* Pp. 1-31, silhouettes in black and white of panorama, life-zones, and taped commentary for each zone. December 15, 1960.

° Out of print.

(Continued on outside of back cover)

(Continued from inside of back cover)

26. Beaver in Kansas. By F. Robert Henderson. Pp 1-85, illustrated. December 16, 1960.
27. Land and fresh-water mammals of the Ungava Peninsula. By Francis Harper. Pp. 1-178, plates 1-8, 3 figures in text. August 11, 1961. Paperbound, $2.00 postpaid from the Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, D. C. 20009.
28. Handbook of unionid mussels in Kansas. By Harold D. Murray and A. Byron Leonard. Pp. 1-184, 45 plates, 42 figures. May 10, 1962. Paperbound, $1.00 postpaid.
29. Farm ponds in Douglas County, Kansas. By Claude E. Hastings and Frank B. Cross. Pp. 1-21. May 17, 1962.
30. Collecting and preparing study specimens of vertebrates. By E. Raymond Hall. Pp. 1-46, 34 figures. May 21, 1962. Paperbound, 50 cents postpaid.
31. Natural History Museum. By Roy R. Moore and E. R. Hall. [An unpaged, illustrated "flier," 14½ in. x 8½ in., printed on both sides, and folded twice.] June 1, 1962.
32. The bobwhite in Kansas. By Gary Packard. Pp. 1-12, illustrated. November 16, 1962.
33. Spiders of the University of Kansas Natural History Reservation and Rockefeller Experimental Tract. By Henry S. Fitch. Pp. 1-202, 104 figures in text. December 20, 1963.
34. Habits of the red fox in northeastern Kansas. By William C. Stanley. Pp. 1-31, 3 plates, 3 figures in text. December 21, 1963.
35. Natural History Museum. By Roy R. Moore and E. R. Hall. [An unpaged, illustrated "flier," 14½ in. x 8½ in., printed on both sides, and folded twice.] March 2, 1964.
36. Caribou Eskimos of the Upper Kazan River, Keewatin. By Francis Harper. Pp. 1-74, 10 plates. April 20, 1964. Paperbound, $1.50 postpaid from the Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, D. C. 20009.
37. The friendly Montagnais and their neighbors in the Ungava Peninsula. By Francis Harper. Pp. 1-120, 20 plates. April 20, 1964. Paperbound, $2.00 postpaid from the Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, D. C. 20009.
38. Plant and animal associations in the interior of the Ungava Peninsula. By Francis Harper. Pp. 1-58, 7 figs., 1 map. April 20, 1964. Paperbound, 50 cents postpaid from the Arctic Institute of North America, 1619 New Hampsbire Avenue, NW, Washington, D. C. 20009.
39. The status of deer in Kansas. By Donald D. Anderson. Pp. 1-36, 8 maps. September 28, 1964.

3 2044 093 361 582